

**IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF NORTH CAROLINA**

DEMOCRACY NORTH CAROLINA, THE
LEAGUE OF WOMEN VOTERS OF NORTH
CAROLINA, DONNA PERMAR, JOHN P.
CLARK, MARGARET B. CATES, LELIA
BENTLEY, REGINA WHITNEY EDWARDS,
ROBERT K. PRIDDY II, WALTER
HUTCHINS, AND SUSAN SCHAFFER

Plaintiffs,

vs.

THE NORTH CAROLINA STATE BOARD OF
ELECTIONS; DAMON CIRCOSTA, in his
official capacity as CHAIR OF THE
STATE BOARD OF ELECTIONS; STELLA
ANDERSON, in her official capacity
as SECRETARY OF THE STATE BOARD OF
ELECTIONS; KEN RAYMOND, in his
official capacity as MEMBER OF THE
STATE BOARD OF ELECTIONS; JEFF
CARMON III, in his official
capacity as MEMBER OF THE STATE
BOARD OF ELECTIONS; DAVID C.
BLACK, in his official capacity as
MEMBER OF THE STATE BOARD OF
ELECTIONS; KAREN BRINSON BELL, in
her official capacity as EXECUTIVE
DIRECTOR OF THE STATE BOARD OF
ELECTIONS; THE NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION; J.
ERIC BOYETTE, in his official
capacity as TRANSPORTATION
SECRETARY; THE NORTH CAROLINA
DEPARTMENT OF HEALTH AND HUMAN
SERVICES; MANDY COHEN, in her
official capacity as SECRETARY OF
HEALTH AND HUMAN SERVICES.

Defendants,

PHILIP E. BERGER, in his official
capacity as PRESIDENT PRO TEMPORE

Civil Action No. 20-cv-457

OF THE NORTH CAROLINA SENATE;
TIMOTHY K. MOORE, in his official
capacity as SPEAKER OF THE NORTH
CAROLINA HOUSE OF REPRESENTATIVES,

Defendant-Intervenors.

REPLY DECLARATION OF DR. MEGAN MURRAY

I, Megan Murray, hereby declare as follows:

Airborne Transmission of SARS-CoV-2

1. Dr. Plush argues that airborne transmission of SARS-CoV-2 is controversial and has not been established. This is an important point because airborne (or aerosol) transmission is less amenable to easily-implemented infection control measures than is transmission through large respiratory droplets, and this therefore makes polling booths and other closed spaces more dangerous than they might be otherwise.

2. To clarify this controversy, it is necessary to distinguish between airborne and droplet-based transmission of respiratory infections. When someone with a respiratory infection coughs, sneezes, talks or sings, they eject mucus and saliva droplets from their mouths. These virus-containing droplets are thought to measure between 5 and 10 micrometers. If ejected droplets are not blocked by a hand over the mouth or a mask, they may land on people or

objects in the immediate vicinity. In general, droplets over 5 micrometers have been considered unable to travel more than 1-2 meters (3-6 feet) and this is the basis for the 6-foot rule recommended by the WHO and other health agencies [1]. Droplets larger than 5 micrometers are usually thought to fall quickly to the ground whereas small droplets can dehydrate and linger as "droplet nuclei" in the air, where they behave like an aerosol and thereby expand the spatial extent of emitted infectious particles [2]. The WHO classifies particles of less than 5 μm as aerosol and those greater than 5 μm as droplets but there is significant variation in the literature regarding the classification of the lower size limit of droplets with some studies demonstrating that even particles with a diameter of more than 10 μm can remain airborne long enough so that it is not appropriate to consider them vehicles of transmission by the "droplet" route [3].

3. Bahl et al. recently conducted a systematic review of the evidence for the horizontal distance travelled by droplets and the guidelines based on these data [4]. They found that the evidence base for the 1-2 meter rule was sparse. Of ten studies on horizontal droplet distance, eight

showed droplets travel more than 2 m (≈ 6 ft), in some cases more than 8 meters (≈ 26 ft). Several studies of SARS-CoV-2 support aerosol transmission, and one study documented virus at a distance of 4 meters (≈ 13 ft) from the patient. They also provide evidence that despite guidelines that suggest otherwise, infections cannot be neatly classified into the droplet versus airborne transmission routes and they argue that the weight of combined evidence supports airborne precautions against Covid-19.

4. Several other recent studies provide support for this theory. These are reviewed by David Helfgott in Infectious Disease Advisor and I cite from this article [5]: "In a study by van Doremalen et al, experimentally-generated aerosol particles with SARS-CoV-2 were found to have virus that was viable in cell culture throughout the 3 hours of aerosol testing [6]. Such laboratory-generated aerosols may not be exactly analogous to human-exhaled aerosols, and measurement of virus exhaled from patients with COVID-19 infection has been reported in several studies. In China, aerosol particles were isolated from air samples collected from various areas in 2 hospitals and from outdoor spaces in Wuhan; virus genome was detectable in some aerosols but at

very low concentrations [7]. A study at another hospital detected SARS-CoV-2 RNA in 35% of aerosol specimens from the intensive care unit and in 12.5% of specimens obtained from a COVID-19 ward [8]. An epidemiologic analysis from China concluded that cases of COVID-19 traced to possible shopping mall exposure may have occurred via aerosol [9]. In a study from Iran, air samples taken from a distance of 2 to 5 m from patient beds were negative for SARS-CoV-2 RNA [10]. However, a study from the University of Nebraska Medical Center demonstrated SARS-CoV-2 genome in 63.2% of air samples from rooms of 11 patients infected with COVID-19, with some samples obtained at distances >6 ft from the patient, and in 66.7% of 12 air samples obtained from hallways outside the patients' rooms [11].” More recently, Stadnytski and colleagues used highly sensitive laser light scattering to show that loud speech can emit thousands of oral fluid droplets per second; these were measured to have a diameter of *approximately* 4 μ m diameter, leading the investigators to conclude that there is a substantial probability that normal speaking causes airborne virus transmission in confined environments [12].

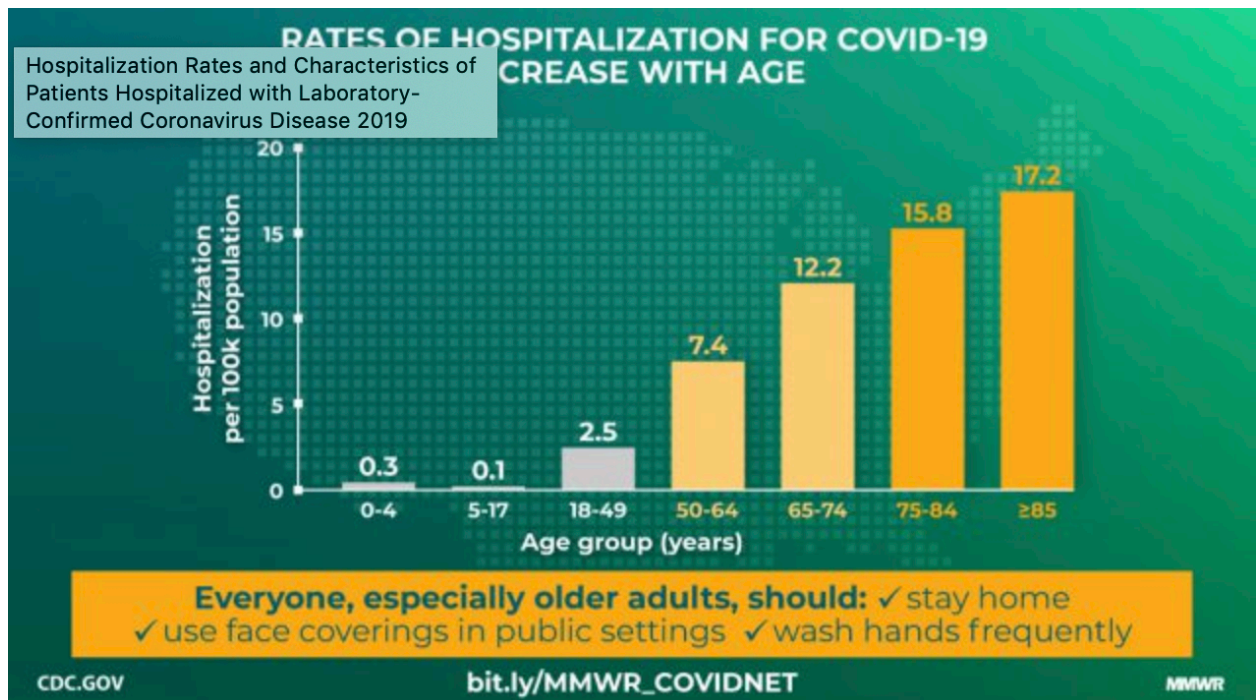
5. In conclusion, the mode respiratory transmission of SARS-CoV2 is incompletely understood, but there is growing

evidence that transmission can occur through both large droplets and by smaller particles (aerosols). Given the possibility of aerosol-based spread, precautions against Covid-19 should include those designed to reduce airborne spread.

Hospitalization Rate

6. Dr. Plush notes from his own clinical experience in New Jersey, and current numbers of confirmed and hospitalized patients in North Carolina that 5% of the current active infections are severe enough to require hospitalization, and he goes on to note that this figure is lower than the 39% considered at higher risk for serious complications. I note that Dr. Plush's experience is consistent with large epidemiologic studies from the CDC for younger age groups, and that hospitalization rates increase with age, as shown in the figure on the next page.

Hospitalization Rates of Covid-19 by Age. [27]
(MMWR.Covid.net)



7. However, the proportion of confirmed Covid-19 cases that are hospitalized depends on who is being tested and therefore is likely to vary from place to place depending on whether the denominator for these estimates includes asymptomatic people who were detected through screening. In areas where testing has been extended to people without symptoms of illness, the proportion of people who are hospitalized is much lower than when only the ill are tested. Notably, current estimates are that only 10% of all people with infection are detected [13].

8. In a recent study from the New England Journal of Medicine, investigators reported on an observational, cohort study that included patients seen at Louisiana health facility between March 1 and April 11, 2020, who tested positive for SARS-CoV-2. Among the 3626 patients who tested positive, 39.7% of the patients were hospitalized with 29.6% of white patients and 41.6% of black patients hospitalized [14].

Possible interventions to limit transmission risk during voting

9. Dr. Plush argues that the risk of infection at polling stations can be eliminated if CDC guidelines for infection control are followed: "By wearing a mask, using hand sanitizer, keeping a safe distance from others and refraining from touching their nose, mouth, and face at the polling station, voters can essentially eliminate the risk of catching the virus while voting in person." I consider each of these interventions and the evidence for their efficacy on preventing transmission.

10. Masks. The evidence on the efficacy of masks in preventing transmission of respiratory viruses is mixed and depends on the type of mask worn and the circumstances of an exposure. Face masks fall into several distinct categories:

disposable N95 and equivalent respirators are test-fitted devices designed to filter small airborne particles, including aerosols. Surgical or medical masks are loose-fitting, fluid-resistant coverings that create a physical barrier, blocking larger particles. Cloth masks are non-medical face coverings that vary with regard to filtration and fluid resistance depending on the material used, the number of layers, and fit. Most studies of cloth masks have evaluated 12-16 layer cotton masks used in Asia but these are not standard in the US and to my knowledge, there have been no systematic trials of cloth masks with fewer layers published to date. Many US-based cloth masks are single layer.

11. Dr. Plush refers to two different systematic reviews on the efficacy of masks in preventing viral respiratory infections. Systematic reviews are compilations of previous studies that address a specific research question and which summarize all the evidence that fits pre-specified eligibility criteria. Based on my reading of the two systematic reviews that Dr. Plush cites, I reach somewhat different conclusions than he did. MacIntyre et al. reviewed 19 randomized controlled studies of face masks (ie. studies which randomly assign people to wear face masks or not), 8 of

which were among community residents, 6 among health care workers and 5 in people with infection (source control studies) to prevent infection of their contacts. For HCWs, the study reported "there is evidence of efficacy of respirators (defined as N95 masks) if worn continually during a shift, but no evidence of efficacy of a (non-N95) mask." The studies in community members all looked at "medical" masks, and none of the 8 studies conducted found a statistically significant benefit to face mask wearing, although several demonstrated a trend for protection that did not meet the statistical criteria necessary to report an effect. Several studies showed that relatively few community members assigned to the mask intervention adhered to the established protocol for mask wearing. Wearing of medical/surgical masks by source cases did show a modest effect in reducing household infection in several of the studies summarized [15].

12. Liang and colleagues performed a meta-analysis which pooled the data from multiple studies and re-calculated the effect estimate based on the pooled sample size. This study found an overall relative risk of .35 which suggested that the protective efficacy of mask wearing is 65%. However, the

study included both randomized clinical trials (which reported a relative risk of .67, suggesting protective efficacy of 33%) and observational studies which reported a relative risk of .24 or 76% efficacy. RTCs are much more likely to be unbiased so this differential suggests that people who wear masks by choice are likely to have a lower risk of infection in general that cannot be attributed to the mask.

13. Furthermore, some of the studies used N95 masks, others medical/surgical masks and in others, the type of mask was not specified. Liang did not provide individual estimates for the efficacy of each type of mask so there is no additional information here on the amount of protection afforded by the type of cloth masks used in the US [16].

14. In another recent study published in the Lancet, Chu and colleagues reviewed data on preventive measures as reported in 172 observational studies on SARS, MERS and Covid-19. This study found an overall relative risk of .33 in mask wearers compared to non-wearers but notes that the effect for N95 masks was more extreme than for medical/surgical masks and even more extreme than for single layer cloth masks. However, they do not provide direct estimates of the efficacy

of cloth masks. The study also found that maintaining at least one-meter distance from an infected person reduced transmission by about 80% and that this protection increased two-fold with each further meter of separation. The authors conclude: "These data suggest that wearing face masks protects people (both health-care workers and the general public) against infection by these coronaviruses, and that eye protection could confer additional benefit. **However, none of these interventions afforded complete protection from infection, and their optimum role might need risk assessment and several contextual considerations** [17]." (emphasis added)

15. Hand Hygiene. There is less data available on hand sanitizers and the prevention of Covid-19. Hand sanitizers have been shown to effectively reduce viable virus on hands, but there have been no clinical trials to assess how this impacts transmission. Hand washing works if an uninfected person's hands are contaminated with Covid-19 either from touching another person or from contaminated objects. However, the CDC notes "transmission of coronavirus occurs much more commonly through respiratory droplets than through objects and surfaces, like doorknobs, countertops, keyboards, toys, etc. [18]" Experts currently acknowledge that it is not

yet possible to know how much hand hygiene contributes to disease risk. As quoted by The New York Times, Dr. Osterholm of the University of Minnesota's Center for Infectious Disease Research and Policy said "he's spent his 40-year medical career trying to convince people to be more diligent about washing their hands to prevent disease – so he doesn't want to say it's not important. But he believes that social distancing will prevent the majority of Covid-19 infections [19]."

16. Staying home when sick. The CDC guidance cited by Dr. Plush also recommends that people should not come to polling stations if they are ill. This will certainly reduce the opportunity for transmission events from these people to other voters. However, if these people had not requested mail-in voting ballots before they developed symptoms or tested positive for Covid-19, they would then be unable to participate in the election. As above, since older people, people of color, and those with co-morbidities are more likely to be ill with Covid-19 at any specific time point, this means this group will be differentially affected by this stipulation. Furthermore, current estimates suggest that only one in ten people with Covid-19 is detected with the remainder

having either mild or asymptomatic infection. These individuals would be physically able to vote in person and may unwittingly spread infection if they did show up at the polls. Thus, while this intervention of self-isolating when sick will disenfranchise some voters, it is unlikely to have a major impact on transmission at polling places.

In summary, the impact of the interventions that Dr. Plush describes depends entirely on what kinds of masks are worn, how compliant users are, whether other people rather than the wearer are complying with mask-wearing, how well polling booths can maintain distance between people, and how much transmission is mediated by aerosols versus large respiratory droplets. Mask wearing has been a matter of major disagreement in North Carolina, where some local politicians and community groups have protested against the requirement to wear masks. For example, Keith Kidwell, a state representative from Chocowinity in eastern North Carolina, argued on the House floor that wearing a mask was a personal decision: "I will not wear a mask, I don't care what the governor says," Kidwell said. Per news reports, a local group that held a protest in front of the state legislature "represented a not-insignificant portion of the population

that not only dismisses the call to wear masks to slow the spread of the virus, but views the mandate as an intrusion on their constitutional rights [20].” Given the resistance to mask-wearing that has emerged in many communities including in North Carolina, it would be difficult to ensure a vulnerable person’s safety by mandating that others must wear masks either while waiting in line or within polling stations. Furthermore, as of now, it will be illegal to wear a mask in public in North Carolina after August 1.

CDC guidelines on accommodations for voting

17. Dr. Plush also notes that compliance with CDC guidelines will effectively reduce transmission risk to zero. Importantly, the CDC guidelines also include recommendations about in person voting and note a “lower risk in election polling settings include those with:

- a wide variety of voting options
- longer voting periods (more days and/or more hours)
- any other feasible options for reducing the number of voters who congregate indoors in polling locations at the same time [21]”

18. Other recommended practices include ensuring adequate ventilation at each polling site, increasing the number of polling locations available for early voting and

extending the hours of operation, maintaining or increasing the total number of polling places available to the public on election day to improve the ability to social distance, minimizing lines as much as possible, especially tightly-spaced queues in small indoor spaces and limiting the number of voters in the facility by moving lines outdoors if weather permits or using a ticket system for access to the facility. Suggested modified procedures include increasing the distance between voting booths to ensure that voters remain 6 feet apart, ensuring sufficient space for social distancing and other measures, identifying larger facilities for use as future polling places, modifying the polling location layout to ensure voters move in one direction while in voting locations and to avoid bottlenecks, such as single doors for entry and exit, notifying voters of changes to polling operations, including the availability of alternative voting options that minimize contact and ensuring that any changes to operations do not limit accessibility to voters with disabilities.

19. It is important to note that it may be difficult or even impossible for polling stations to accommodate all of these safeguards. At the recent state election in Kentucky,

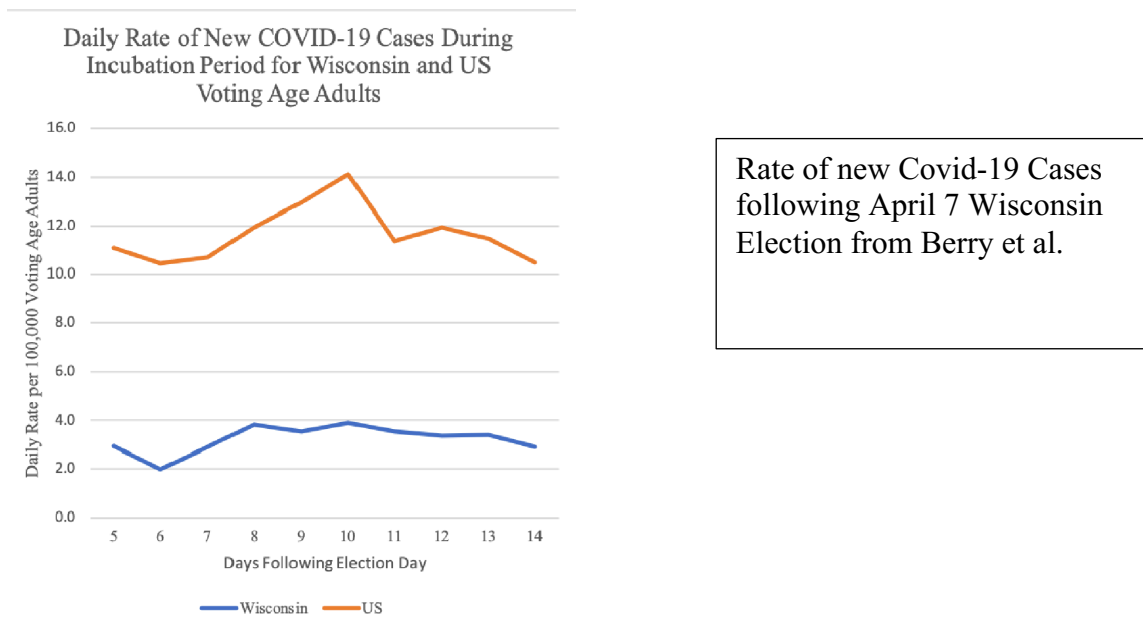
the state responded to constraints caused by Covid-19 by reducing the number of polling locations rather than increasing them - from a former average of around 3,700 locations to 170 locations, with the state's two most populous counties having just one in-person polling location each.

Empirical data on Wisconsin elections

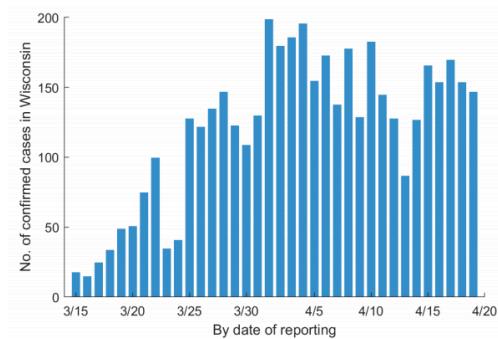
20. In addition to these studies and recommendations, there is some empirical evidence that in-person voting can increase Covid-19 risk. Wisconsin held an election for national primaries and state positions on April 7, 2020 in which mail-in voting was allowed and a large portion of the electorate chose that route with an estimated 1.1 of the 1.55 million total voters submitting absentee votes. In the aftermath of that election, the Wisconsin Department of Public Health conducted contact tracing that identified 71 confirmed cases of COVID-19 among people who may have been infected during the election. Dr. Plush notes that these people may have been infected elsewhere and that is certainly possible although difficult to verify.

21. Two studies suggest that voting did not lead to a "surge" in Covid-19 cases after the election while a third more recent study found a significant association between in-

person voting and the spread of COVID-19 two to three weeks after the election. I will briefly review and critique these studies. On April 28, Berry et al, posted a pre-print on the server, Medrxiv, that showed that the number of reported Covid-19 cases reported in Wisconsin in a fourteen-day period following the election did not exceed the rates reported prior to that period. This study did not consider infections that were detected more than 14 days after the election and thus only looked at infections that occurred on the day of polling and not the indirect effect of further transmission from people who were infected on election day. The report looks at temporal changes in Covid-19 in a single location without assessing other possible factors associated with changes in incidence over that time period [22].



22. On April 29, Leung et al. also posted a pre-print in which they estimated the number of transmission events that took place on April 7 based on the number of reported cases that occurred after a delay meant to capture the incubation period and delay in patient presentation and subsequent reporting of Covid-19 [23]. These authors used a deconvolution method to estimate the number of transmission events that occurred on election day. Based on this analysis, the authors also found no association between the election and Covid-19 case rates.



Number of confirmed cases of
Covid-19 following April 7
Wisconsin Election from
Leung et al.

A

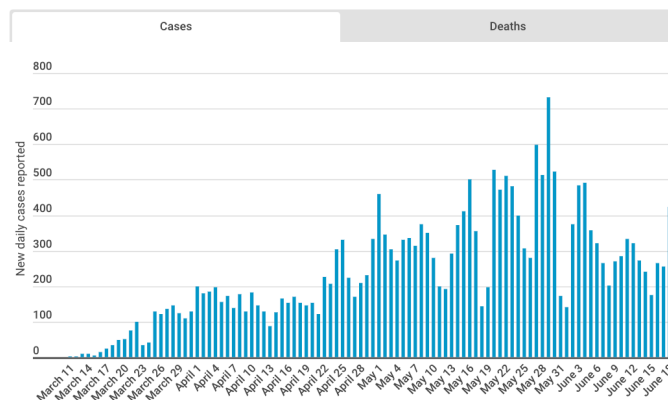
Note that the graphic shown below corresponds to the longer-term data provided by the Wisconsin Department of Health Services which shows a rise in cases beginning around May 21 and including a subsequent period that was not captured in the Berry or Leung data.

New COVID-19 Diagnoses and Deaths in Wisconsin, March-June 2020



Wisconsin's first confirmed case of COVID-19 was announced on Feb. 5, 2020. More than a month passed before another case was confirmed on March 9, followed by a swift rise in new cases confirmed daily.

On Thursday, June 18, the Wisconsin Department of Health Services reported 422 new cases and 7 new deaths.



Source: Wisconsin Department of Health Services

Number of confirmed cases of
Covid-19 following April 7
Wisconsin through June 18

23. Cotti et al. conducted a third study which differed from the previous two in that 1) it compared county-level data on the proportion of people voting in-person and the proportion of Covid-19 tests that were positive; 2) it extended the time period assessed until May 3; 3) it factored measures of social distancing and county-specific demographics (population, population density); and 4) it used the proportion of tests that were positive rather than just positive cases to control for temporal differences in testing. This study found that counties with higher than average in-person voting had twice the rate of Covid-19 positive tests in the weeks that followed the election. Across a range of exploratory models, the team found a large post-election increase in Covid-19 cases in counties that had more in-person votes per voting location, all else being equal. They also noted a decrease in the number of new positive Covid-19 cases in counties with relatively more mail-in absentee votes after accounting for differences in in-person voting, county-level COVID-19 testing, and population measures. I consider this third paper a much more rigorous and persuasive study given the thorough attempt to determine the relationship between the amount of in-person voting per

polling station and subsequent Covid-19 diagnoses in the relevant counties. The quantitative comparison between different counties with different levels of in-person voting and subsequent outcomes makes this a more reliable approach than a simple time series that does not adjust for other factors as in the first two studies cited. I therefore conclude that in-person voting in Wisconsin did indeed pose a risk to voters [24].

24. Notably, this occurred despite rigorous attempts by the state to ensure voting safety for the approximately 440,000 people who voted in person. In a memo to the Wisconsin Elections Commission, Meagan Wolfe, the Commission's Administrator, reported on a long list of measures taken and products obtained to address sanitation and personal protective gear [25]:

Wisconsin's 72 county clerks played a key role in distributing supplies to more than 2,000 polling places. Supplies that were distributed include:

- Over 8,000-liter bottles of liquid 70% ethyl alcohol solution that was used as a hand and surface sanitizer. The solution was sourced from a local distillery as all other state and national supply chain options were exhausted
- Over 10,000 16oz plastic spray bottles and printed labels for the bottles for the liquid alcohol solution

- 500,000 isopropyl alcohol wipes for use on voting equipment and electronic touchscreens.
- Surgical masks for poll workers
- Latex gloves for poll workers
- 1.5 million ballpoint pens so that each voter would have their own to sign the poll book and mark their ballot
- ~2,000 rolls of painter's tape to facilitate social distancing
- 10,000+ social distancing and public health signs

The National Guard helped with the packaging and distribution of supplies from the stockpile in Madison to regional facilities around the state. The counties then drove to the regional facilities, or coordinated pick up in vehicles large enough, to bring the supplies back to the county office for distribution to the municipalities and/or each polling place.

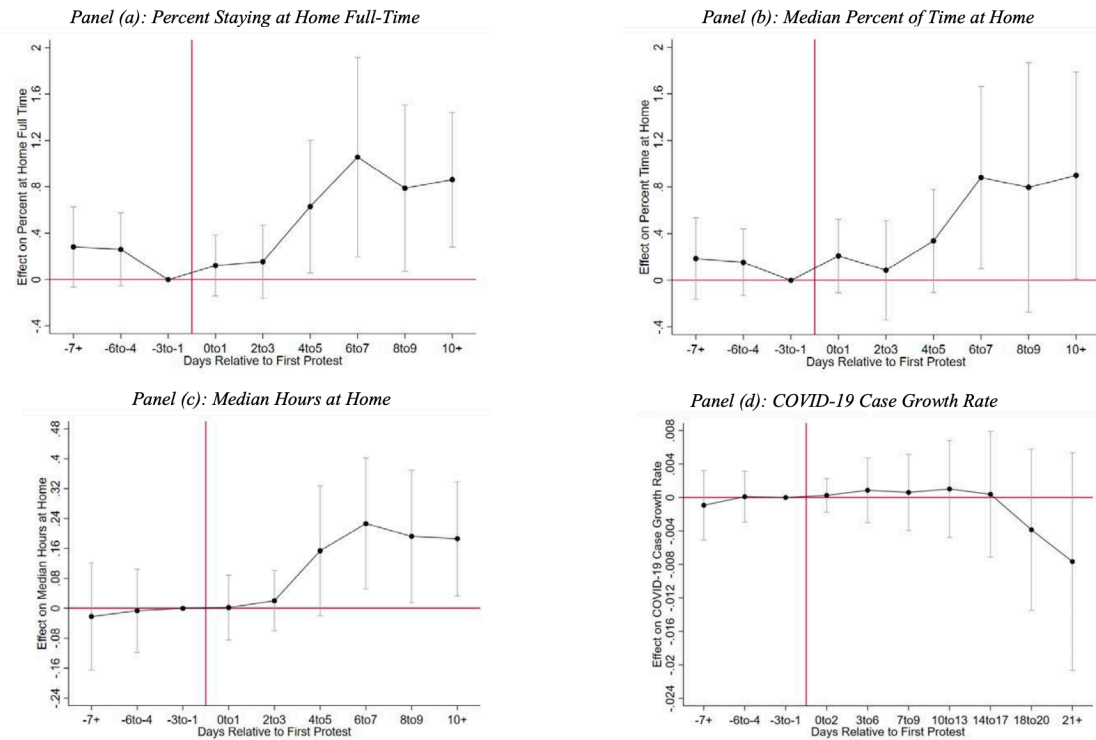
In summary, despite labor-intensive and costly efforts to maintain the safety of in-person voting during the Wisconsin election, a rigorous study provides support for the contention that this election increased Covid-19 transmission.

Black Lives Matter Protests and Covid-19

25. Dr. Plush also raises a point about protests in support of Black Lives Matter and the spread of Covid-19. Specifically, he cites a paper from the National Bureau of Economic Research that concluded "that the protests had little effect on the spread of COVID-19 for the entire population of the counties with protests during the more than

three weeks following protest onset.”³⁴ He states that “this counters the predictions that the protests would bring broad negative public health consequences and demonstrates that people can remain relatively safe in a wide variety of settings.” Importantly, however, the study that he cites also provides data that supports a different interpretation of the lack of effect of the protests on increasing Covid-19 transmission. The study compared both social distancing data (from Safe Graph, Inc., which provides an anonymized population movement dataset of nearly 45 million smartphone devices aggregated to the census block, county, and state levels) and Covid-19 incidence in 315 cities that had protests with 34 cities that did not. The authors demonstrate that cities with protests saw an increase in social distancing behavior for the overall population relative to cities that did not and that this increase was commensurate with modest evidence of a small longer-run case growth decline. The investigators speculate the overall increase in social distancing may have been due to fear of Covid-19 transmission, fear of violence during the protests, or problems with blocked streets that might have led to transportation delays [26]. These data are shown in the figure below drawn from the paper.

Figure 2. Event Studies Analysis of the Effects of Urban Protests on Social Distancing and COVID-19 Cases Growth



26. Thus, while it is true that the protests did not increase Covid-19 infection rates, this is likely to have been the result of self-imposed restrictions in movements on the part of residents of the affected cities. A similar result would not be an optimal outcome of the upcoming election if it means that people do not vote because they are afraid to go out. Furthermore, transmission risks are expected to be higher in indoor spaces without direct exposure to ultra-violet light from sunlight.

I declare under penalty of perjury under the laws of the United States of America that the foregoing Declaration is true and correct to the best of my knowledge.

Executed on the 2nd day of July, 2020.

A handwritten signature in black ink, appearing to read "Megan Murray", with a horizontal line underneath.

Megan Murray

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